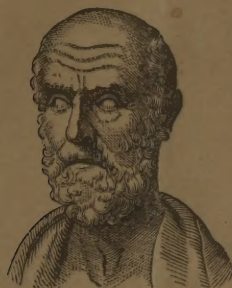


DALTON. (J. C.)

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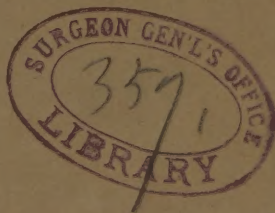
UNA FIDES, ALTARE COMMUNE.

OBSERVATIONS ON TRICHINA SPIRALIS,

By JOHN C. DALTON, M.D.

PROFESSOR OF PHYSIOLOGY IN THE COLLEGE OF PHYSICIANS AND SURGEONS, N. Y.

PRINTED FOR THE ACADEMY.

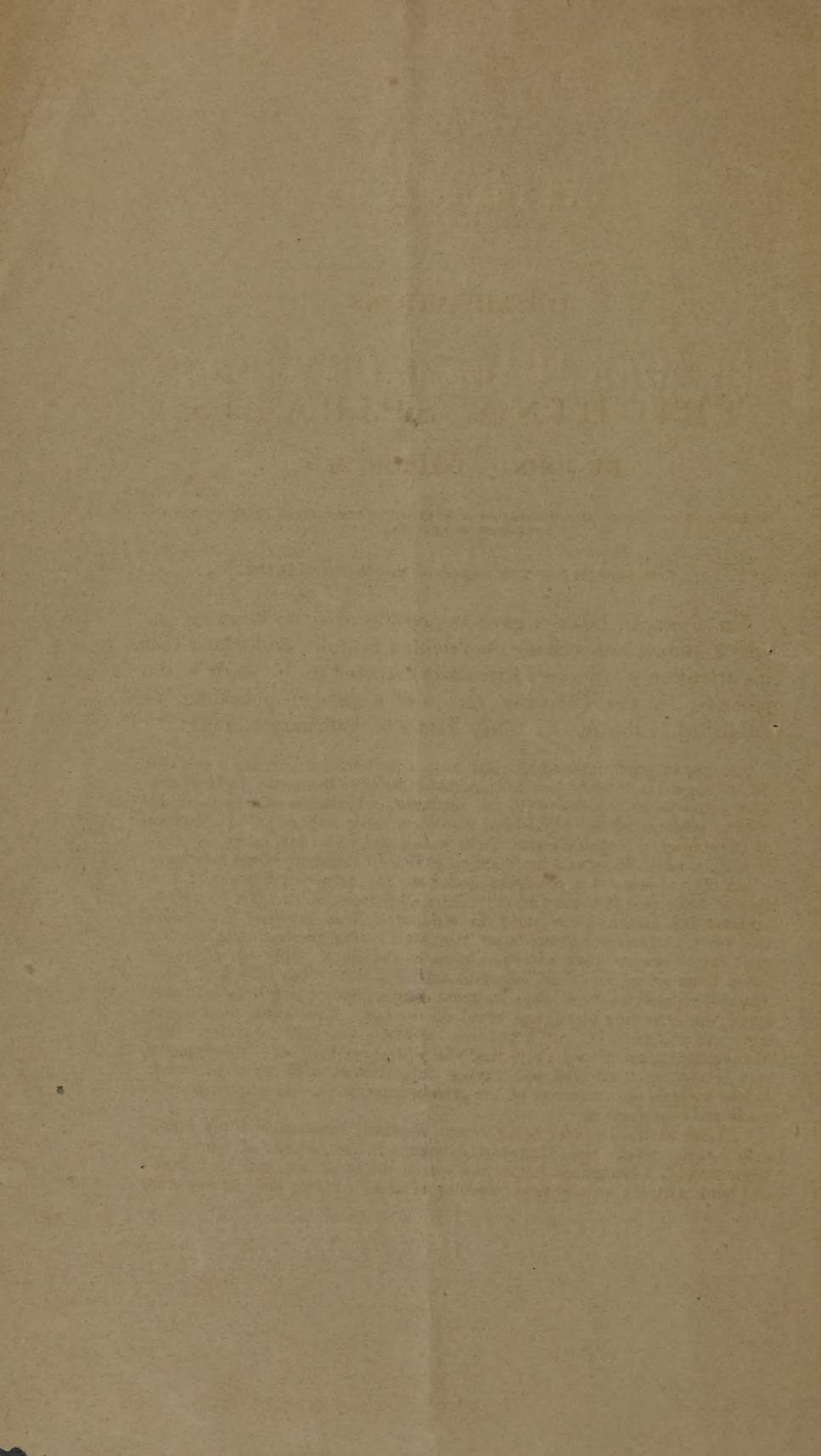


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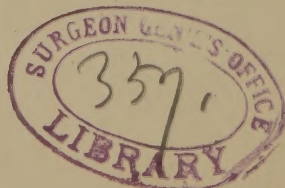
PROFESSOR OF PHYSIOLOGY AND MICROSCOPICAL ANATOMY IN THE COLLEGE OF PHYSICIANS AND SURGEONS OF NEW YORK.

Read before the New York Academy of Medicine, March 16, 1864.

DR. JOHN C. DALTON gave an account of some observations which he had lately made on *Trichina Spiralis*, and stated that his attention was more particularly directed to the study of the parasite, by the following report of a case of poisoning, as published in the *N. Y. Daily Times* of February 5, 1864:

"A case of much interest has just been concluded by Coroner NAUMANN. As we regard it of some public importance we give below the facts as they have come to us, together with the testimony adduced on the inquest, including evidence of the physicians, who have made a thorough examination of the subject. It appears that three weeks ago yesterday, an elderly lady, Mrs. ELIZABETH WERKMEISTER, residing at No. 45 Elizabeth street, purchased a ham at the store of a provision dealer on the corner of Grand and Mott streets. She took it home and the family all partook of it. Mr. FLAIG, the husband and father of the family, his wife, their little daughter MARY, aged two years, and an aunt of the latter, soon after eating, became quite ill. The next day, however, they ate some more of the ham. This second repast made them worse, and they began to attribute it to what they had eaten. The child lingered several days in great distress, and at length died, in spite of all the attending physicians could do for her. The father, mother, and aunt are still very ill, but hopes are entertained of their recovery. Mrs. WERKMEISTER, mentioned above, and who is the grandmother of the deceased, was not so much affected, she having only eaten a small piece to test it. Below we give the testimony of the grandmother and of the physicians who made the examination.

"*Elizabeth Werkmeister* being sworn, testified: Deceased was my grand-child; three weeks ago Thursday, I bought a ham, corner of Grand and Mott streets; I brought it home, and we all ate of it raw, and took bread and wine with it; on the next morning deceased's father and mother were



taken very ill; they complained of a great pain in the stomach, &c.; on that day they ate more of the ham, and since that time they have been constantly very ill; they thought the ham poisoned them, and I ate a piece of it to try it; the same symptoms showed themselves with me; afterwards the deceased was taken sick, and Dr. Valliere was sent for.

"Dr. Valliere, residing in Jackson street, testified: I am a physician; two weeks ago to-day I was called to see deceased; I found her in great pain, vomiting, &c.; these symptoms continued for four or five days; the deceased gradually grew weaker, and died day before yesterday; all the members of the family were similarly affected; the family consisted of the father, mother, grandmother, aunt, and deceased; they were all of the opinion that the sickness was caused by eating a ham, which they had purchased a short time before; on examining the ham with a microscope it was found to be diseased, and filled with a kind of insect known as '*trichina*.'

"Joseph Schnetter, of No. 99½ Amity street, testified that he was a physician; that he saw deceased in consultation with Dr. Valliere; deceased was suffering from symptoms described by the doctor; my opinion was that the disease was caused by the '*trichina spiralis*;' I took a piece from the same ham that deceased had eaten, and examined it under a microscope; I found that it contained an immense number of the animalcules; as far as the appearance of the ham with the naked eye went, it seemed to be healthy; nothing wrong could be detected with the naked eye, and no blame could be attached to the dealer for selling the article. I have seen several cases of disease from the same cause, and believe it to be more prevalent this season than others.

"Dr. Wooster Beach testified: I have made a post-mortem examination of the body of deceased, with Drs. Valliere, Schnetter, and Jacobi; the organs showed no marks of disease, except the brain and left lung, which exhibited signs of congestion; portions of various parts of the body were removed for microscopic examination; I agree with Dr. Schnetter in his opinion as to the cause of the death of deceased.

"At the conclusion of the testimony, the jury rendered the following verdict: 'We find that the deceased, Mary Flaig, came to her death from accidental poisoning from eating ham containing *trichina spiralis*.'

Dr. Dalton then proceeded:

The existence of *Trichina spiralis* has been known for about thirty years. For a long time, however, it was supposed to be peculiar to the human subject, and all that was definitely known, with regard to its locality, was that it was confined to the voluntary muscles. It has often been found in the muscles of dissecting-room subjects, and I have had in my possession for the last ten years a fine specimen of the rectus femoris muscle, from a dissecting-room subject, which is filled with these parasites. In this and similar specimens the parasites are inclosed in cysts, which are very easily recognised by their appearance, and are even visible to the naked eye, notwithstanding they are only $\frac{1}{32}$ of an inch long, and $\frac{1}{160}$ of an inch in thickness; this, however, is owing to the fact that the cysts, in these speci-

mens, are filled with a calcareous deposit, which gives them a dense opaque, whitish appearance.

The cysts are somewhat shuttle-shaped, swollen in the middle and tapering at the extremities. The worm, which has a very characteristic contour, being coiled spirally upon itself, is found in the central part of the cyst; while the deposit of calcareous salts occupies the extremities.

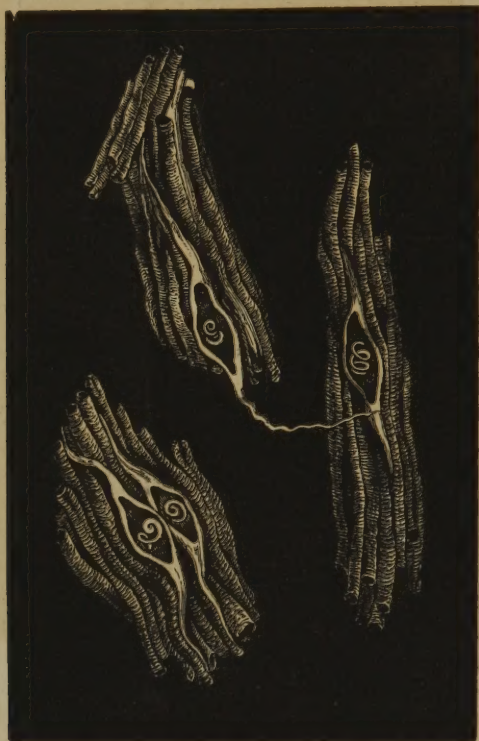
In all instances, until recently, in which these worms had been found, notwithstanding that all the voluntary muscles, even to the muscles of the larynx and those of the middle ear, were infested by them, it was never known that they produced any injurious effects. Indeed, in some instances, persons, in whom this state of things existed, were positively known to have been in the enjoyment of good health before death. The trichina was supposed to be a harmless parasite.

I must confess that this was the extent of my own knowledge in reference to them, when I saw the account, which I have just read, of a family being poisoned by them. By the kindness of Dr. Voss I came in possession of a part of the ham which was the cause of the poisoning in this case, and on examining it by the microscope I found, as Dr. Schnetter had stated, that it was filled with trichinæ. But these parasites, in their microscopic appearances, were somewhat different from those with which I was already familiar in the human subject.

The first thing which struck me was their quantity. In a piece of muscle, $\frac{1}{12}$ inch square and $\frac{1}{36}$ of an inch thick, where they were in average abundance, I counted twelve trichinæ. This would give, in round numbers, over 85,000 to the cubic inch. In this ham the trichinæ were inclosed in cysts, as in other cases, but these cysts differed from those found in the human subject in not being the seat of calcareous deposits. Hence they were nearly as transparent as the muscular fibres themselves, and for this reason, as well as for being somewhat smaller, they were not visible to the naked eye. The cysts in the ham were $\frac{1}{8}$ of an inch long, and $\frac{1}{145}$ of an inch in thickness. They were also peculiar in having long caudate processes, or prolongations, running out from their two extremities. In the human subject the cysts terminate by rounded extremities, which are perfectly distinct, but in the ham these extremi-

tics taper off into long processes, which are of such length that I have never been able to find their ends. In tearing

FIG. 1.

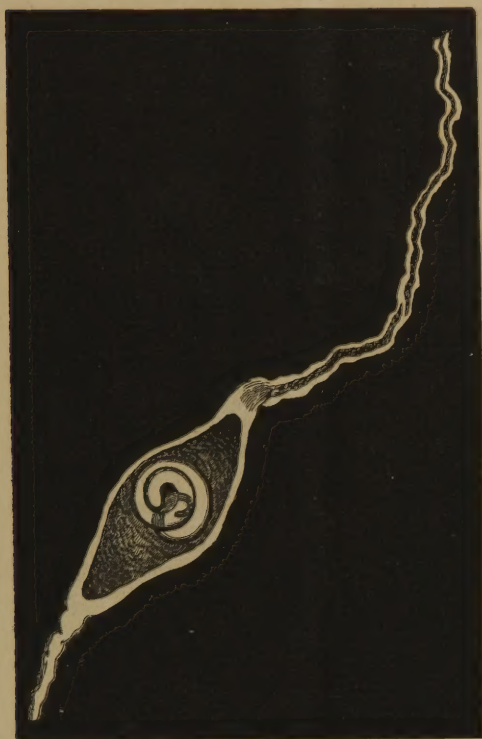


TRICHINA SPIRALIS, IN CYSTS, FROM MUSCULAR TISSUE OF HAM.

the muscular fibres apart for microscopic preparation, these filamentous prolongations are torn off at various distances from the cyst, and this is not to be wondered at when we remember how closely they are interwoven with the muscular tissue (Fig. 1). It requires considerable care to extricate a cyst even with one of these prolongations undetached. Such a one is represented in this drawing (Fig. 2).

The cyst is spindle-shaped as in the human subject, with the worm coiled up in its central part, but merges at once from each extremity into its prolongation. The structure of the

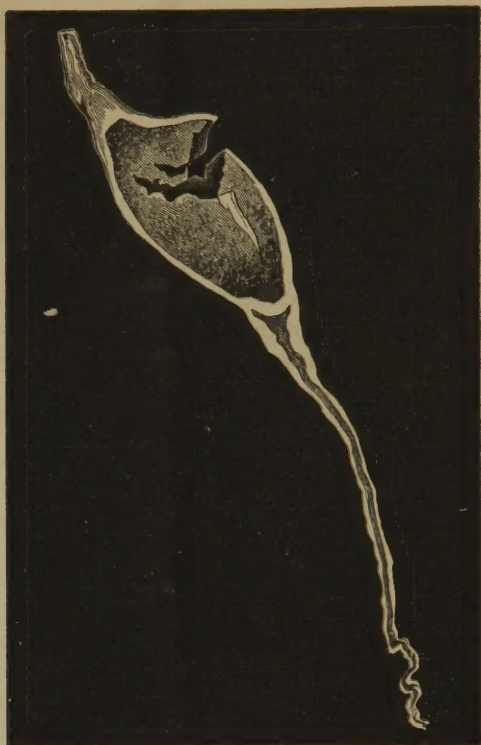
FIG. 2.



TRICHINA-CYST, FROM HAM.

cyst is peculiar. It consists of a hollow sac; but the cavity of the sac does not communicate with the interior of the prolongations. The walls of the sac are tolerably thick, but transparent and colorless; and at each end of the cyst its cavity terminates by a rounded cul-de-sac. In its interior there is a deposit of granular matter, which makes the outline of the cavity tolerably distinct, while at the same time it somewhat obscures the outlines of the worm itself. Sometimes by pressure the sac may be ruptured and the worm expelled, and then it is easy to see that it has a distinct cavity, which was previously occupied by the worm imbedded in a soft granular material (Fig. 3). The nature of the prolongations of the cyst was a matter of great interest to me, and the first specimen,

[Fig. 3.]



TRICHINA-CYST, FROM HAM, BROKEN OPEN AND EMPTY.

which I had the opportunity of examining from the ham, showed several facts not described by previous observers. In the first place, after some care, it was found that these prolongations are invariably present at both extremities of the cyst. Some writers occasionally speak of the cysts as sometimes having one prolongation and sometimes two, but in this specimen the latter was always the case. Secondly, the prolongation is *tubular in character*. A granular matter fills its cavity in the same way as that of the cyst, but in the tubular prolongation it is less dense and more transparent. This granular matter appears in most instances gradually to disappear as we approach the cyst, but in favorable cases it may be seen to

come up nearly to the cavity of the cyst, and is in reality simply separated from it by a perfectly defined wall or partition, of the same thickness and appearance as the wall of the cyst itself. (Figs. 3 and 5.) In some instances I have seen even a second cavity, beyond the end of the cyst, shut off also from the tube by a second transverse partition. I have also noticed, in several instances, that by pressure upon the unruptured cyst the transverse partition which separates the two cavities may be broken down, and the granular contents of the cyst forced out into the cavity of the tubular prolongation. Then, with regard to the character of the cyst wall and the wall of the tube, they appear to be without definite structure; for if a portion of the lacerated cyst wall be examined with a high power, it presents only a very finely striated appearance, similar to that seen in fibrinous exudations, but does not show any indication of a definitely fibrous texture.

If the trichina be expelled from the cyst by pressure, and examined by itself, it is seen to be a round worm, $\frac{1}{24}$ of an inch long, and $\frac{1}{820}$ of an inch in thickness. In the cyst it lies coiled up in three turns, so that the tail is opposite to, and very near the head; but after extricating it from the cyst, I have often been able to unwind it sufficiently for purposes of measurement and examination. It has an anterior extremity which is rather pointed and narrow, and a posterior extremity which is comparatively thick and blunt. It has a very thin and transparent, but strong and elastic integument, which is covered with exceedingly minute annular grooves, which give a finely serrated look to its free edges. It has an alimentary canal, which commences by a mouth at the anterior extremity, followed by a narrow œsophagus, which soon dilates into a large intestine, occupying nearly the whole thickness of the body of the animal. About two-thirds of the distance from the mouth to the anus, this intestine very suddenly diminishes in size, then enlarges again into a kind of pouch, and then diminishes again to a narrow tube, which continues, following the curve of the body, until it reaches the posterior extremity, where it communicates with the anus. In the posterior third of the worm, besides this smaller part of the intestine, there is another body, with regard to the nature of which there has existed some

FIG. 4.



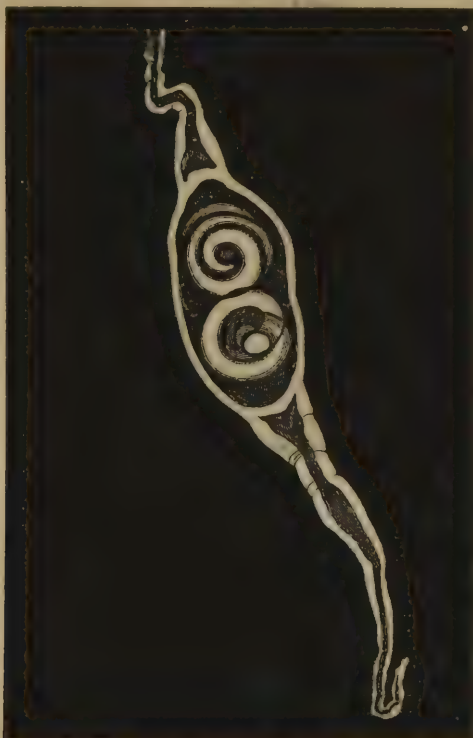
TRICHINA SPIRALIS, FROM HAM, MAGNIFIED 210 TIMES.

doubt. It is a wide tube, having no apparent opening in either direction, which occupies most of the thickness of this part of the worm, and is very distinct in consequence of being filled with a large number of highly refractive, oleaginous-like globules. This body is supposed to be the germ or origin of the generative apparatus; but if so, it is entirely undeveloped and imperfect, as there are no signs of any distinct sexual organs. Indeed, one of the most interesting circumstances in regard to this parasite has always been the fact that it is sexless, and its existence, therefore, difficult to account for. These, then, are the most important points connected with the anatomy of the parasite. There are various other accounts given by different observers in regard to its structure, but I have only

referred to those particulars of which I have satisfied myself by direct observation.

A very difficult point, and one which I found it impossible to settle from an examination of the first specimens that came under my notice, is that regarding the exact *location* of these worms. What is the nature of this tubular cyst in which they are contained? Usually one worm alone occupies the cavity of a cyst, but occasionally there are two together (Figure 5).

FIG. 5.



TRICHINA-CYST, WITH TWO WORMS, FROM HAM.

One specimen from the ham showed a very curious pair of cysts, running continuously into each other, by means of their prolongations (Figure 6). It was very evident from the examination of these and similar specimens, that the worms were con-

FIG. 6.



TRICHINA CYSTS, CONNECTED, FROM HAM.

tained, either in the cavities of bloodvessels very much altered from their normal condition, or in the interior of the muscular fibres themselves. So long as these parasites were only found in the human subject, it was supposed that their cysts were either egg-membranes belonging to the worm, or products of exudation thrown out from the muscular tissue. But the tubular prolongations which I have described are evidently nothing which belongs to the worm itself, and must therefore be derived from the tissues in which they are found.

The cyst, with its prolongations, must therefore be one of three things. Either, 1st, an inflammatory exudation thrown out immediately around the worm and along the track through which he has come; or 2d, a muscular fibre with its sarcolem-

ma thickened and its contractile matter degenerated and atrophied; or 3d, a bloodvessel thickened and distended at the situation of the worm, and collapsed and partly solidified above and below. The first of these suppositions, however, cannot be the true one, since I have found the prolongations always at both ends of the cyst, and indefinite in extent; and though we might very readily imagine an exudation thrown out behind the worm, along the course which he has followed in order to arrive at his present situation, this does not explain why there should be a similar one, of the same extent, in *front* of him. The cyst must therefore be either a muscular fibre or a bloodvessel. Both Leuckart and Virchow assert it to be a muscular fibre, in the interior of which the worm establishes himself, after arriving in the muscular tissue. The appearances which I have seen in later observations lead me to believe that it is a bloodvessel, by which the worm has been brought to his present situation, and in which he is finally fixed at a particular spot.

The pathological relations of the worm are of still greater interest. Dr. Schnetter, of Amity street, who is very familiar with this subject, informs me that he has had a previous case, of his own, of undoubted poisoning by *trichina spiralis*. The case was that of two servant girls in the upper part of the city, who were taken sick about the 20th of January, shortly after having eaten a meal of pork steaks, which were very much underdone. Dr. Schnetter was so much convinced of the truth of his suspicions, that he made inquiry as to the condition of the rest of the family, and found that they had not partaken of the meat, and that they consequently had not suffered any inconvenience. One of the servant girls, shortly after having eaten the pork, went to live in another family, and on making inquiry, Dr. S. found that she too had been taken sick and suffered from the same symptoms as the first.

It seems that this trouble, from eating pork infested with *trichina spiralis*, which I think is somewhat new in this country, has been for the last four years tolerably well known in Germany, and is generally recognised there, as a disease to be looked for and diagnosticated.

Dr. Krackowitzer has kindly loaned me a recently published pamphlet by Virchow, in which he gives a full account of the

history of this disease since the year 1860, a short abstract of which was published in the AMERICAN MEDICAL TIMES for February 20th. It seems that not only is trichina found in ham and in all kinds of pork, but that its bad effect upon the human subject, when taken in the food, is fully recognised. In Germany the trichina disease has been noticed in quite a number of cases, and there have been no less than five distinct epidemics of it. The first case happened in Dresden, in 1860. A family partook of recently killed pork, and all the members, together with a servant girl, were taken sick with the peculiar symptoms belonging to this affection. The servant girl died. At the autopsy her muscles were examined and found to be full of the trichina. Virchow repeated the same examination, with the same result. He administered a part of these muscles to a rabbit as food, and the animal, who ate freely, died at the end of a month. The muscles of this animal were then given to a second rabbit, who died four or five weeks afterward; and the muscles of the second rabbit were then given to a third, which also died at the end of a month. In all these cases the muscles of the rabbits were found full of the trichina spiralis; thus showing beyond a doubt that the fatal effects were due to the trichina, and that the parasite could be propagated from one individual to another by being administered in the food.

One of the most remarkable of the German epidemics was that which happened in Hettstadt, in which nearly 150 people were affected, and over twenty died.

About the same time that my attention was directed to the existence of trichina in ham, Dr. Voss was kind enough to invite me to see a case of recent trichina disease on board one of the Bremen ships in our harbor. It seems that on this ship the captain, first mate, second mate, and cook were taken sick simultaneously, on the 5th of February. Dr. Betzendorf was called on the 8th, and, from the symptoms which were present, suspected the existence of trichina disease. These symptoms were abdominal pain and diarrhoea soon after eating of the suspected food, followed within a day or two by œdema of the face. At the time Dr. Betzendorf was called, the patients were suffering from anorexia, and some fever. Dr. Voss was then sent for in consultation. He was not able to trace the

illness to any particular article of food, unless it were some pork which had been eaten a short time before the patients were taken sick. In order to satisfy himself fully, however, as to the nature of the disease, Dr. Voss cut down upon the deltoid muscle of the second mate, and removed a portion of its tissue for examination. It proved to be filled with *trichina spiralis*. Dr. Voss was kind enough to give me a portion of the same muscle, and I also found in it an abundance of trichinæ, similar to those of the ham. They were not, however, quite so abundant, numbering, in the human muscle, only a little over 7000 to the cubic inch.

Another point, however, of great interest was elucidated by the examination of these specimens from the human muscle. It was very evident that although the trichinæ in the human muscle were the same animals with those in the ham, their cysts presented a very different appearance (Fig. 7). Instead of being contained in closed fusiform sacs, with narrow prolonga-

FIG. 7.



TRICHINA, IN TUBULAR CYST, FROM RECENT HUMAN MUSCLE, TAKEN THE 13TH DAY OF ILLNESS.

tions, the worms were here evidently in the cavity of continuous tubes, which were only slightly dilated at the point where the

parasite was lodged. There were no transverse partitions, shutting up the worm in a cavity of its own, but by proper manipulation and gentle pressure, the worm could be readily forced into the neighboring undilated portion of the tube, and back again into its wider part, as in the specimen shown in Fig. 7.

Usually, when undisturbed, the worm lay fully coiled up, as in the other specimens. The wall of this tubular cyst is much thinner than that in the specimens from the ham.

Other appearances in the wall and contents of this tubular canal lead one to the belief that it is nothing else than a dilated and altered bloodvessel (Fig. 8).

FIG. 8.



TRICHINA, IN TUBULAR CYST, FROM RECENT HUMAN MUSCLE, TAKEN THE 13TH DAY OF ILLNESS.

Its cavity is filled with a granular material, which is much less opaque than that contained in the older trichina-cysts of the ham, and which appears to be the coagulum remaining in an obstructed vessel. There are collected at various points in this granular matter little bodies which can hardly be mistaken, and which are evidently more or less altered blood-globules. The wall of the tube also shows upon its internal surface thin flat nuclei, similar to those of the smaller bloodvessels.

From these observations, accordingly, it would appear that the

worm is actually contained within a bloodvessel, and that it is conveyed throughout the system and reaches the muscular tissue by the circulating current, and that it then becomes arrested, and finally stops the circulation in the vessel which contains it.

There is also another fact which corroborates this view of the case, and which is important as being one of the earliest symptoms in trichina disease. I refer to the œdema. This appears usually very early in the face, and soon after becomes general. It was well marked all over the body in the case from which Dr. Voss obtained the specimens which I have described. This œdema, which would be very difficult to explain on any other supposition, is easily understood by an arrest of the circulation taking place simultaneously in so many capillary bloodvessels, as must necessarily be obstructed, when 7,000 trichinæ are contained in the space of a cubic inch. These parasites must produce a retardation in the flow of blood, which is the true cause of the effusion of serum in the surrounding tissues. At the time Dr. Voss obtained the specimen mentioned above, the disease was in its second stage, the patient complained of muscular pains, and the anasarca was general.

It appears, therefore, from all these sources of information that the trichina is very common as a parasite in pork; and this circumstance, connected with the fact that it is not only communicable to the human subject, but that it gives rise to a very troublesome and fatal affection, is a matter of great importance for the general public as well as for the profession. It seems that the history of the ingestion and propagation of these parasites is as follows: The patient takes, for food, ham or pork, which is not thoroughly cooked. It is important to notice that *smoking* alone does not kill the trichinæ, even when it is very thoroughly done. Dr. Schnetter informs me that the ham which produced the sickness in the Elizabeth street family, was an American ham, thoroughly smoked, and not to be distinguished by anything in its appearance from any other ordinary ham. The prevalence of this disease, as well as that of the tapeworm, especially among the Germans, is undoubtedly owing to their habit of eating hams, sausages, and sometimes fresh pork in a raw state. At all events, it is thorough cooking

alone which will afford protection against poisoning by either of the parasites infesting this kind of food.

So long as the worms occupy the muscular tissue they are perfectly quiescent, and, as I have said, sexless. But as soon as they are taken into the stomach and the muscular fibres digested, the worms, according to the observations of Leuckart and Virchow, pass into the intestine, where they immediately begin to grow, attain rapidly three or four times their former size, acquire fully developed generative organs, and, in the course of a week to ten days, the female contains an abundance of living young. These young, as soon as discharged into the intestine, begin to work their way through the mucous membrane, penetrate the bloodvessels, are distributed all over the body—become arrested in the capillary bloodvessels of the voluntary muscles, obstruct these vessels, grow to a certain size, and there remain stationary. While penetrating in such large numbers through the intestinal mucous membrane, they produce abdominal pain and diarrhœa, which are the first symptoms of the attack. As soon as they arrive and become fixed in the muscular tissue, they cause universal muscular pains, often very severe, anasarca, anorexia, and fever of a typhoid character. In the fatal cases, death generally takes place at the end of four or five weeks from the commencement of the attack, and is due to the intensity of the febrile symptoms. The child in Elizabeth street, however, who was seen by Dr. Schnetter, died exhausted by the diarrhœa at the end of two weeks. If the patient survives the first few weeks of the attack, the muscular tissue accommodates itself to the presence of the inactive parasite, the obstructed vessel shrinks and becomes obliterated, while others in the neighborhood undoubtedly become dilated and fully restore the circulation. Fibrinous partitions are thrown across the obstructed vessel in the immediate neighborhood of the parasite, inclosing him in a shut sac, while the rest of the vessel becomes gradually converted into the narrow prolongations which I have described. After some years these prolongations even disappear altogether, and the worm is then inclosed in a simple fusiform cyst, with rounded extremities. Calcareous matter is in the meantime slowly deposited, particularly in the ends of the cyst, so that it becomes hard, white,

and opaque. This is the condition of those specimens usually found in dissecting-room subjects. Exactly how long they may remain in this state is not definitely known, but from a very curious observation made by Langenbeck in 1863, and mentioned in the article already adverted to in the *Amer. Med. Times* of February 20, it appears certain that they may remain perfectly recognisable for at least eighteen years in the human muscular tissue without producing any inconvenience, beyond the first few weeks after their ingestion.

The mystery heretofore attending the appearance of trichina spiralis is therefore partially cleared up. The propagation of these worms is analogous, to a great extent, with that of the cysticercus and tape-worm. The cysticercus occupies, in great numbers and in a quiescent and immature condition, the cellular tissue of the pig. The pig's flesh is eaten by a man, and in the human intestine one of the cysticerci becomes developed into a tape-worm, with fully formed sexual organs, and capable of producing living embryos. The fruitful and mature tape-worm-articulation, full of young, is thrown off and discharged from the intestine, and afterward devoured by a pig. In the pig's intestine the young embryos are set free, perforate the mucous membrane, enter the bloodvessels, are distributed over the body, and become fixed and encysted in the cellular tissue as cysticerci. There is a regular and necessary alternation between the immature cysticercus in the flesh of the pig, and the fruitful tapeworm in the human intestine.

In the same way the trichina remains immature while in the muscular flesh, and becomes fruitful only when introduced into the human intestine.

But a great difficulty has been still thought to exist with regard to the continued propagation of this worm. If the immature trichinæ of the infested pork become fruitful when eaten, and produce a new brood, and if this new brood immediately penetrate the mucous membrane and are distributed over the muscular system of the patient, there to become encysted and quiescent, how is a third brood ever to be produced? How is the parasite ever to get back again to the muscular flesh of the pig, there to continue its propagation on being eaten by a man?

I believe this difficulty, however, to be only an apparent one. We must not suppose because the young brood of some of the mature trichinæ are discharged in the human intestine, to penetrate through the mucous membrane to the muscles, that *all* of them follow this course. It seems more probable that a portion, if not most, of the fruitful trichinæ pass out of the intestine, like the tapeworm-articulation, with the fæces, and only discharge their living brood when subsequently eaten by the pig. If this be so, the infection of the human muscular system by trichinæ should be regarded as a kind of accident owing to the rapid development and discharge of some of the young broods before the adult worms have left the intestine. A similar occurrence happens sometimes with regard to the tapeworm. For though generally the mature articulations containing the young are discharged entire from the intestine, so that we only find cysticercus in the flesh of the pig and only tœnia in the human intestine, *occasionally* one, two, or even more cysticerci are found in the human subject, where they have been seen in the muscular substance of the heart, in the cellular tissue, in the eye, and in the brain.

In the case of trichina, the tendency of a portion of the new brood to find their way into the human muscles is much greater than in that of the tœnia, and constitutes the most annoying and dangerous circumstance connected with the disease. But so far as the physiological history of the parasite itself is concerned, this circumstance is altogether secondary. The history of the propagation of trichina spiralis, like that of tœnia and cysticercus, is that of a regular and natural alternation between the immature encysted sexless parasite in the pig's flesh, and the fully developed fruitful worm, reproducing its species in the human intestine.

